

## **Historic, Archive Document**

Do not assume content reflects current scientific knowledge, policies, or practices.





# Food & Nutrition Research Briefs

## **Why Megadoses of Beta Carotene May Promote Lung Cancer**

A study of ferrets—which metabolize beta carotene very much like humans—shows that excess beta carotene stored in the lungs becomes oxidized into products that turn the normal control of cell division upside down. These oxidized metabolites decreased a tumor suppressor and increased a tumor promoter in the animals' lungs. The finding explains why very high doses of beta carotene appeared to increase lung cancer rates among smokers in two large intervention trials reported in 1994 and 1996. One of those trials—the National Cancer Institute's CARET study—was cut short because of this increase.

By contrast, there are no reports of harmful effects from low-dose beta carotene supplements. And populations that eat more fruits and vegetables rich in beta carotene and other carotenoids reportedly have a lower incidence of cancer, particularly lung cancer. The ferrets got the human equivalent of 30 milligrams of beta carotene daily—the dose given in the human intervention trials. The average beta carotene intake from U.S. diets is 2 to 5 mg a day. The researchers encourage getting 8 to 10 mg daily through the diet. That means eating plenty of carrots, dark green vegetables, cantaloupe, sweet potatoes, pumpkin, peaches, mangos or other foods rich in this orange pigment and other carotenoids—such as lycopene and lutein.

Normally, body cells convert some of the beta carotene into a vitamin A-like compound, retinoic acid. Retinoic acid is reported to dampen cell division and is currently being used to treat skin cancer and leukemia. But an excess of beta carotene exposed to the high oxygen levels in lung cells—along with the oxidizing effects of cigarette smoke—apparently wreaks havoc with this fine-tuned system. In the ferrets, the oxidized beta carotene metabolites destroyed retinoic acid, thereby decreasing its tumor-suppressing activity. At the same time, they turned up the volume on a protein that activates cell division, promoting precancerous lesions, the researchers reported in the *Journal of the National Cancer Institute* (vol. 91, pp. 60-66).

Each day for six months, one group of ferrets was given the beta carotene supplements and exposed to cigarette smoke—equivalent to a person smoking 1.5 packs a day. Two other groups got either the supplement or smoke exposure for the

same length of time, while a control group got neither. The group getting both treatments had the strongest precancerous changes. The products of genes that promote cell division were three- to fourfold higher in these animals than in the control group.

For more information, contact Robert Russell, (617) 556-3335, or Xiang-Dong Wang, (617) 556-3130, Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA; [russell@hnrc.tufts.edu](mailto:russell@hnrc.tufts.edu); [wang\\_cn@hnrc.tufts.edu](mailto:wang_cn@hnrc.tufts.edu)

## **Dress Rehearsal: Researchers Pass "Bird Flu" Test**

In May 1997, a 3-year-old boy in Hong Kong died of the flu and the world held its breath. Soon, this tragedy would spark new scientific collaboration thousands of miles away at an ARS poultry research lab in Athens, Georgia. What was so disturbing about the boy's death was that the culprit virus had previously attacked only birds—poultry in particular. Why had the "bird flu" changed hosts?

Understanding how and why influenza viruses mutate is critical to avoiding disasters like the Spanish Influenza. In 1918 and 1919, the Spanish flu killed nearly 22 million people in North America, Europe and Asia. Similarly, Hong Kong and China have been starting points for world pandemics. Fortunately, the 1997 "bird flu" known as H5N1 never came close to causing a pandemic. But the episode became an important test of how the world will respond to the next worldwide attack of avian influenza.

When the boy died in 1997, scientists at an ARS poultry research lab in Athens, Georgia, already had a working H5 influenza vaccine for birds. They had been studying a viral strain that attacks only poultry but is related to H5N1, the Hong Kong bird flu strain. Based on this work, the scientists and industry cooperators provided the Hong Kong government with the poultry vaccine. The ARS scientists also provided the Centers for Disease Control and Prevention with a temporary research facility. They worked extensively with CDC to identify the virus and understand its frightening changes. A report of this joint research appears in the *Journal of Virology* (vol. 72, pp. 6678-6688).

For more information, contact David Swayne, (706) 546-3433, Southeast Poultry Research Laboratory, Athens, GA; dswayne@arches.uga.edu

## **Device Protects Chickens From Salmonella at Hatching**

A new device from ARS research clears disease-causing organisms from the air in poultry houses, protecting chicks the moment they hatch. Airborne particles often give *Salmonella* bacteria a free ride to chicks' feathers and lungs. One infected chick can quickly spread the bacteria throughout an entire hatching cabinet. That increases the risk of *Salmonella* for consumers as adult birds are grown for food.

The ARS researchers recently applied for a patent on their system that uses a negative electrostatic charge to collect dust particles in hatching cabinets. The system charges airborne dust and deposits it onto plates that are automatically rinsed several times an hour. In laboratory tests, it reduced *Salmonella* by 95 percent in week-old birds and in egg-laying hens. Similar results were gotten in commercial hatching cabinets where hatchability was improved an average of 2.7 percent, the researchers reported in the *Journal of Applied Engineering in Agriculture* (vol. 14, pp. 551-555).

In other experiments with *Salmonella*-infected chicks, it reduced airborne transmission by 99 percent. But the system may offer even more protection: preliminary tests with the laying hens seem to show the charge kills bacteria outright.

For more information, contact Bailey Mitchell, (706) 546-3443, Southeast Poultry Research Laboratory, Athens, GA; baileym@bae.uga.edu

## **Protecting Chickens from Salmonella Starts With the Egg**

A simple three-step process can help poultry producers keep *Salmonella* and other food pathogens out of poultry—and may increase profits. It all begins with the egg, according to ARS scientists. The steps involve cleaning the eggs, treating chicks with a safe spray and using beneficial microbes to protect growing birds.

First, farmers spray freshly laid eggs with a mild detergent and a reliable farm disinfectant chemical. This lowers surface contamination from bacteria. Next, hatcheries spray a fine mist of hydrogen peroxide or other effective chemical in the cabinet while chicks are hatching. This protects the newly hatched chicks from airborne *Salmonella*. And last, in the grow-out house, workers give benign gut bacteria from healthy mature chickens to young chicks to prevent colonization by *Salmonella*. Even if chicks come in contact with *Salmonella*, they will not become carriers.

The researchers confirmed the effectiveness of the first step with a producer, which is reported in the *Journal of Applied Poultry* (vol. 6, pp. 298-305). This producer found cleaning and disinfecting eggs paid for itself because more of the eggs could be sold at a higher price. A dozen clean hatching eggs sell for about 30 cents. A soiled dozen sell for only about 7 cents for use in pasteurized egg products. ARS scientists estimate that a large-scale farm selling millions of eggs annually could recover the cost of the spraying equipment in two years.

For more information, contact Mark Berrang, (706) 546-3551, Richard B. Russell Agricultural Research Center, Athens, GA; mberrang@ars.usda.gov

## **Young Rats Shed Light on Aging Brain**

There's now more evidence that cumulative oxidative damage to brain cells causes the fuzzy memory, slow learning and loss of coordination that often accompanies aging. Using young rats, researchers have developed a model for the aging brain that will help them learn what counteracts the damage to brain cells caused by naturally generated oxygen free radicals.

The researchers produced losses in cognitive and motor function in young rats by first reducing levels of a natural antioxidant, glutathione, in the animals' brains. Then they added the hormone dopamine, which rapidly oxidizes, generating free radicals. By contrast, rats continued to function like young animals when they were given extra dopamine while their antioxidant (glutathione) levels were still high. The rat model and results of learning and memory tests are reported in *Free Radical Biology & Medicine* (vol. 23, pp. 412-418, and vol. 24, pp. 1149-1158).

This further supports the case that antioxidants may prevent or slow the loss of motor control—as well as memory and learning ability—associated with aging. The brain is rather deficient in natural antioxidants, especially considering that it uses a lot of oxygen, which generates free radicals. It also harbors high concentrations of iron—a strong oxidizer—and is rich in fatty acids, which are highly vulnerable to oxidation. Studies show that antioxidant levels diminish with age. So the aging brain appears to be an easy target for oxidative damage.

The researchers developed this young animal model because old animals are very expensive and may have impaired vision—a factor that would confound the learning and memory test. They will use this model to test the protective effects of antioxidant vitamins and other beneficial compounds in plant foods, or phytonutrients, such as flavonoids. They will look for antioxidants that cross the blood-brain barrier and compounds that stimulate the cells to produce adequate levels of natural antioxidants.

For more information, contact Barbara Shukitt-Hale, (617) 556-3118, Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA; hale\_ne@hnrc.tufts.edu



## **Hormone May Explain African-American Girls' Energy Efficiency**

African-American teenage girls tend to be taller and heavier and to mature faster than their peers in other ethnic groups. A new study suggests one possible explanation: African-American girls in the study had higher blood levels of leptin, a hormone that helps cue "fullness."

Manufactured in fat tissue, leptin is a biochemical cue for curbing appetite and burning calories. It and another hormone—neuropeptide-Y, which triggers hunger—help control the cycle of hunger and satiety. When blood leptin runs higher, however, the body may require more to "hear" its biochemical message, according to the study leader.

The researchers conducted the study with 136 healthy volunteers—79 white and 57 African-American girls—all students in the Houston, Texas, area. They ranged in age from 8 to 17 years. The findings, published in the *Journal of Clinical Endocrinology and Metabolism* (vol. 83, pp. 3574-3577), help fill gaps in data on energy metabolism in the African-American population.

Medical research has suggested that higher leptin levels may speed sexual maturity and make the body better at conserving energy. Higher energy efficiency could help explain why African-American girls grow faster than peers in other ethnic groups. This metabolic efficiency can backfire in adulthood by contributing to obesity and increased health risk. But the new study adds further evidence that establishing healthy life styles in childhood can have lasting beneficial effects into adulthood.

*For more information, contact William W. Wong, (713) 798-7168, Children's Nutrition Research Center, Houston, TX; [wwong@bcm.tmc.edu](mailto:wwong@bcm.tmc.edu)*

## **High-Protein Bean May Improve Soy Infant Formula**

Prolina, a high-protein soybean originally bred for animal feed, appears to have the right amino acid mix to make soy infant formula more like mother's milk. Among Prolina's appealing qualities is an unusually high concentration of cysteine, an amino acid that occurs naturally in human breast milk. In fact, Prolina has several times more cysteine than regular soybean varieties.

Humans have a higher ratio of cysteine in their breast milk than all other mammals. Scientists have speculated that high cysteine levels promote brain and eye development because the body uses it to make taurine, a compound highly concentrated in these organs.

Formula manufacturers have been looking for a way to more closely match mother's milk with a vegetable-based formula. Prolina may just be the formula for success.

Breast feeding is preferable to formula for all infants, but sometimes this isn't possible, particularly if the infant has trouble digesting larger proteins found in breast milk. Soy formula can be an alternative.

Prolina soybeans are high in 11S and 7S proteins, a special class of proteins with enhanced functional properties. This means it's easier to process these beans into a gel form for a fat-free whipped cream made from soy or to blend them into a liquid emulsion like infant formula, according to an ARS chemist. He has been working with food scientists at North Carolina State University to develop new products, such as high-protein soyburgers, based on Prolina's properties.

*For more information, contact Prachuab Kwanyuen, (919) 515-2734, Soybean and Nitrogen Fixation Laboratory, Raleigh, NC; [prachuab\\_kwanyuen@ncsu.edu](mailto:prachuab_kwanyuen@ncsu.edu).*

## **Blueberries Not Equal in Antioxidant Power**

Of more than 50 plant foods tested in an ARS laboratory, blueberries score among the highest in antioxidant power. And animal studies in this laboratory suggest that eating blueberries and other high-antioxidant fruits and vegetables may retard the oxidative damage to tissues associated with aging. Now the researchers have found a three-fold difference in blueberries' ability to subdue oxygen radicals, depending on species and maturity at harvest.

Using the ORAC assay for total antioxidant capacity, they analyzed commercial blueberry varieties and less common species from the United States and Canada. They also analyzed the closely related bilberry from Germany. Results are published in the *Journal of Agricultural and Food Chemistry* (vol. 46, pp. 2686-2693).

Overall, the German bilberry scored highest in antioxidant capacity. However, lowbush blueberries from Nova Scotia and some other U.S. cultivars were quite close to the bilberry in antioxidant capacity, depending upon their stage of maturity.

Naturally ripened blueberries not only taste better than berries picked before their prime, they may be more healthful than fruits picked early for long shipments. Mature berries from two commercial rabbiteye cultivars—Brightwell and Tifblue—scored one and one-half to more than twice as high as berries picked seven weeks earlier from the same bush. That's due to the increase in antioxidant pigments, or anthocyanins, as the berries mature. Region did not affect the antioxidant score, based on analyses of berries from the northern highbush variety, Jersey, grown in Oregon, Michigan and New Jersey.

*For more information, contact Ronald L. Prior or Guohua Cao, (617) 556-3310, Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts, Boston, MA; [prior\\_us@hnrc.tufts.edu](mailto:prior_us@hnrc.tufts.edu); [cao\\_am@hnrc.tufts.edu](mailto:cao_am@hnrc.tufts.edu)*

## Reading Tea Leaves

Next to water, tea is the most consumed beverage world-wide. And it's one of a few food products known to contain significant levels of potent antioxidants known as catechins. So ARS scientists recently measured catechins in various black tea products, including bags, instant iced tea mixes, bottled and herbal teas. Catechins (pronounced CAT-eh-kins) belong to a loosely knit family, known as the flavonoids, which have been noted for their antioxidant activity.

Teas brewed from bags had the highest catechin content along with the highest caffeine content. However, there was a twofold difference in catechin content among the 12 black teas tested. It ranged from 122 micrograms per milliliter (ug/ml) for a brewed decaffeinated tea to 250 ug/ml for a brewed regular tea. Decaffeinated teas had lower levels of catechins. The highest levels are equivalent to the levels in green tea, which has been touted for its health-giving properties.

Instant (powdered) tea mixes, on the other hand, had little or no catechins—with a couple of exceptions. Bottled and herbal teas had none. These analyses were part of a larger effort in ARS' Food Composition Laboratory to compile information on health-enhancing phytonutrients in foods.

*For more information, contact Gary Beecher, (301) 504-8356, Beltsville Human Nutrition Research Center, Beltsville, MD 20705; [beecher@bhnrc.usda.gov](mailto:beecher@bhnrc.usda.gov)*

## Tomato Products With More Beta Carotene

Fresh tomatoes, tomato sauces and juices promise to have much more beta carotene, thanks to new tomato breeding lines developed by an ARS scientist. Three of the lines—for use in processing into paste, juices and sauces—contain about 10 to 25 times more beta carotene than typical tomatoes. They have already been released to interested breeders.

High beta-carotene cherry and beefsteak type tomatoes will also be released as specialty tomatoes for the fresh market. The United States is number two in fresh and processed tomato production worldwide, with Florida and California the top producing states.

Consumers soon may be able to get plenty of beta-carotene from eating pizza, spaghetti and other tomato-based dishes. A major food producer is already using the material derived from the ARS germplasm to develop nutritionally enhanced products. The human body converts beta carotene into vitamin A and other important compounds, such as tumor suppressing retinoic acid.

*For more information, contact John Stommel, (301) 504-5583, Vegetable Laboratory, Beltsville, MD; [jstommel@asrr.arsusda.gov](mailto:jstommel@asrr.arsusda.gov)*

The United States Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, gender, religion, age, disability, political beliefs, sexual orientation, and marital or family status. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at 202-720-2600 (voice and TDD).

To file a complaint of discrimination, write USDA, Director, Office of Civil Rights, Room 326-W, Whitten Building, 14th and Independence Avenue, SW, Washington, DC 20250-9410 or call 202-720-5964 (voice or TDD). USDA is an equal opportunity provider and employer.

The *Research Briefs* is published quarterly by ARS Information. For further information or addition to the mailing list, contact Judy McBride, nutrition editor, at (301) 504-1628; or write her at 5601 Sunnyside Ave., Rm. 1-2212-b, Beltsville, MD 20705-5129; [jmcbride@asrr.arsusda.gov](mailto:jmcbride@asrr.arsusda.gov)